

SUBJECT: Scheduling of Three Skylab  
Medical Experiments - Case 610

DATE: September 30, 1970

FROM: B. H. Crane

ABSTRACT

Four basic approaches to scheduling medical Experiments M092, M093, and M171 are examined with respect to a basic in-flight work week, including continuous manning of the ATM console during crew working hours. The four approaches may be described qualitatively as follows:

1. No more than one experiment trial per man per day
  - a. Same experiment for each crewman
  - b. Different experiments for each crewman
2. All three experiments assigned to the same subject consecutively in a single trial
  - a. One subject per day
  - b. Up to two subjects per day

If Experiment M093, Vectorcardiogram, is scheduled once every third day for each crewman, as presently required, none of these approaches permits scheduling every seventh mission day as a "day off" for the crew. This difficulty can be resolved by allowing days off to fall six or eight days apart, where necessary, or by scheduling at least one trial of M093 on each day off. The alternative is to allow trials of M093 to be scheduled two or four days apart where necessary.

Real time departures from scheduling patterns established by any of the four approaches will be difficult to achieve without violating medical-experiment scheduling constraints. This emphasizes the desirability of minimizing interference between EREP opportunities and scheduled medical experiments.

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MEMORANDUM FOR FILE

I. Introduction

The highest priority experiments on the first Skylab mission include medical experiments, Apollo Telescope Mount (ATM) experiments, and the Earth Resources Experiment Package (EREP). These experiments will be scheduled relative to a basic cycle of daily crew living, systems housekeeping, and mission-related tasks. Conflicts in scheduling high priority experiments must be resolved as a basis for examining further the options available for scheduling corollary experiments.

In addition to Experiment M071,\* which is scheduled along with meals, three medical experiments are highly constrained relative to the basic cycle of eating and sleeping:

1. M092 - Inflight Lower Body Negative Pressure
2. M093 - Vectorcardiogram
3. M171 - Metabolic Activity

Each trial of these experiments must be preceded by at least three hours of fasting by the subject. More flexibility exists in the scheduling of a fourth experiment, M131 - Human Vestibular Function, because it can be scheduled anytime after an hour of fasting by the subject.

It is highly desirable to minimize the interference between scheduling of these medical experiments and full manning of the ATM console for monitoring of solar activity.

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\*Activities scheduled as M071 are associated with the following four medical experiments:

- M071 - Mineral Balance
- M073 - Bioassay of Body Fluids
- M074 - Specimen Mass Measurement
- M172 - Body Mass Measurement

It is also desirable to incorporate as much flexibility as possible in scheduling the medical experiments so that EREP passes can be scheduled in real time without conflict. EREP experiments cannot be scheduled reliably pre-mission because cloud cover and the exact geometry of passes over candidate sites cannot be accurately predicted.

Four alternative approaches to scheduling M092, M093, and M171 are examined in this memorandum for the first Skylab mission (SL-1/SL-2). Scheduling of these experiments is based on major blocks of crew time required for the activities of interest, subject to a set of ground rules and constraints presented in the Appendix. The purpose of these schedules is simply to obtain an overall look at some of the options presently available for scheduling high-priority experiments.

## II. Basic Cycle of Daily Crew Activity

The basic cycle of daily crew activity during on-orbit phases of a Skylab mission is shown in Figure 1, obtained from Reference 1. A fourteen-hour period each day is devoted primarily to sleeping, eating, personal hygiene, mission planning, and free time for the crew. The remaining ten hours in the crew day are available for experiments, lunch, and daily systems housekeeping activities. Lunch may be scheduled within plus or minus an hour of the time shown.

Systems housekeeping tasks are not yet well defined. They may include monitoring, maintenance, and other repetitive operations associated with inhabiting the cluster. One and a half hours per man is allotted each day to cover these tasks. Although there is a general desire to distribute system monitoring throughout the day (as in Figure 1), it is assumed that these tasks can be rescheduled, if needed, to accommodate medical experiments, ATM monitoring, or EREP passes.

In addition to the tasks shown in Figure 1, all three crewmen devote as much as half an hour after each meal to tasks associated with Experiment M071. These tasks are scheduled as half hour blocks for purposes of this study. The time actually required is contingent upon whether a crewman consumes all food prescribed for a given meal and how often he uses the waste management facilities.

With the exception of M071, it is assumed that experiments cannot be scheduled before the second full crew day of the mission nor after the twenty-fifth crew day to permit time for activation and deactivation of the workshop. The twenty-sixth mission day is largely taken up by an EVA

# TYPICAL CREW DAY

CREW-- MAN	HRS	0	1	2	3	4	5	6	7	8	9	10	11	12
1	PH	PH	EAT		S/HK 1.5			EAT				PH FLOAT ING		
2	PH	PH	EAT					EAT		S/HK 1.5		PH FLOAT ING		
3	PH	PH	EAT					** EAT 1.0				PH* FLOAT ING 0.5	S/HK 1.5	

3

12	13	14	15	16	17	18	19	20	21	22	23	24
	EAT	*** MISSION PLAN - NING	*** OFF DUTY	PH				SLEEP				
	EAT	MISSION PLAN - NING	OFF DUTY	PH				SLEEP				
	EAT 1.0	MISSION PLAN - NING 1.0	OFF DUTY 1.0	PH 0.5				SLEEP 8.0				

PH - PERSONAL HYGIENE  
S/HK SYSTEMS HOUSEKEEPING

\*--ASSUMED COMPATIBLE WITH ATM

\*\*--AT ATM CONSOLE OR NONCURRENT WITH OTHER CREWMEN

\*\*\*--WILL BE DELETED ON ONE CREWMAN TO INCREASE ATM VIEWING TIME

FIGURE 1--BASIC CYCLE OF DAILY CREW LIVING (FROM REFERENCE 1)

for ATM film retrieval. The present baseline flight plan for SL-1/SL-2 also shows an EVA on the seventeenth mission day for Experiments D021 and D024.\* Days seven, fourteen, and twenty-one are days off from all experiment tasks except M071.

### III. Manning of the ATM Console

Continuous observation of solar activity is desired at the ATM console throughout the crew's working hours, except during EREP passes. Normally the sun is visible to the spacecraft over roughly two-thirds of each orbit. Longer daylight passes occur for values of  $\beta$  above fifty degrees.\*\* At the highest values of  $\beta$  that occur during Skylab missions, the sun can be visible continuously for several days. Not all of this time is available for solar viewing, however, because the sun is still masked by the earth's atmosphere during part of each orbit. In addition, approximately a third of each orbit is normally devoted to dumping accumulated momentum in the control moment gyros (CMG's).

This study adheres to the presently baselined plan to have the ATM console continuously manned during crew working hours. One crewman will have to eat lunch at the ATM console, unless lunch can be staggered to permit a change of crewmen inbetween. If a crewman is required to eat lunch at the console, it is assumed that M071 can be scheduled without conflict. One crewman is also at the ATM console during the "evening" portion of the crew day while the other two crewmen are doing mission planning or are off duty.

Continuous manning of the ATM precludes scheduling other tasks along with trials of M092, M093, or M171, which require both a subject and observer. Thus, systems housekeeping cannot be scheduled in the late "afternoon" of the crew day when medical experiments are scheduled at this time, using the ground rules adopted in this study. Some trials of M092, M093, or M171 must be scheduled in the late "afternoon" to permit time for days off from these experiments, as shown in the sample schedules.

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\*D021 - Expandable Airlock Technology  
D024 - Thermal Control Coatings

\*\* $\beta$  is the angle between the spacecraft orbital plane and a line between the center of the earth and the center of the sun.

#### IV. Earth-Resources Opportunities

EREP experiments must be performed during a pass over some pre-selected site, most often within the continental United States, which meets specified conditions of geometry, lighting, and visibility through cloud cover. Potential EREP opportunities over the U.S. may occur at various times throughout the crew's working day. Since specific EREP passes cannot be firmly scheduled until a few hours before their occurrence, some potential opportunities may be blocked by a previously-scheduled medical experiment. Sufficient flexibility is not always available to reschedule the medical experiment without violating the medical constraints discussed in the following sections.

At least two crewmen are required to execute an EREP pass. One prepares for and initiates a maneuver of the cluster to a Z-local vertical attitude. This maneuver begins after sunrise. The other crewman activates the experiments. During passes over the target, one man is required at the experiment console while the other tracks the target through a viewing telescope.\* One crewman is required post-pass to monitor the maneuver back to a solar-inertial orientation, which is completed before sunset. The maximum time required for this sequence would be around an hour, since  $\beta$  must be less than  $50^\circ$  for maneuvers to a local-vertical attitude.

#### V. Overall Requirements for Scheduling M092, M093, and M171

The objectives of M092 and M171 call for a minimum of five trials per subject on the SL-1/SL-2 mission, using all three crewmen as subject.\*\* Trials of M093 are to be scheduled every third day for each crewman during the mission, permitting

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\*Tracking a target through a telescope is required for Experiment S191 - Infrared Spectrometer.

\*\*Only five trials per subject are required for M092 by the Experiment Requirements Document (ERD) presently in effect (Reference 3), although eight trials per subject have been included in baseline reference flight plans. Modes B and C of Experiment M171 are being cancelled, and the number of trials of Mode A, Resting Metabolic Rate and Bicycle Ergometry, are being increased to five on SL-2. Documentation of these changes is being processed.

eight trials per crewman throughout the twenty-four day span allotted to experiments. This required frequency is in basic conflict with the objective to schedule a day off every seventh day during the mission. If M093 is scheduled to leave days seven and fourteen free, for example, one trial per subject will have to be scheduled on the twenty-first mission day. The sample schedules constructed in this study give priority to the required frequency of M093, moving the day off whenever necessary.

Trials of M092, M093, and M171 must all be scheduled in either the late "morning" or late "afternoon" of the crew day, due to the requirement for three hours of fasting by the subject prior to collecting this data. An additional requirement is that trials of M092 or M171 for the same subject be scheduled at approximately the same time of day. Parameters being measured in these experiments are subject to 24-hour cyclic variations (circadian rhythms).

It is also highly desirable to schedule M092, M093, and M171 so that any one subject does not have to emplace and remove the vectorcardiogram electrodes more than once in any one crew day. Trials of all three experiments require these sensors. Emplacement and removal of the electrodes causes skin irritation, which is increased by the length of time the sensors are in place.

Four possible approaches to scheduling these three medical experiments on SL-1/SL-2 are examined in this study, which may be described qualitatively as follows:

1. Three trials of the same experiment for different subjects in one day.
2. Up to three trials of different experiments for different subjects on the same day.
3. One trial per day that may include M092, M093, and M171 in sequence for the same subject.
4. Up to two trials on one day that may include M092, M093, and M171 in sequence for the same subject to permit some days off.

#### VI. Trials of One Experiment on the Same Day

The first approach examined in this study is to schedule trials of one experiment for each of the three crewmen on the same day. With trials of M093 scheduled every third day,

it is possible to fit in five days of M092 and five days of M171 with a variable spacing of four to six days between trials of each experiment for the same subject. Days on which the various trials are scheduled in the sample timeline are summarized in Table I, which corresponds to Figure A-1 in the Appendix.

This solution permits a day off for all three crewmen on days seven, fourteen, and twenty-two, but not twenty-one. If the frequency of days off were deemed to take priority over the M093 requirements, three trials of M093 could be moved from the twenty-first to the twenty-second crew day.

The sample schedule in Figure A-1 shows one medical trial in the late "morning" opportunities and two trials in late "afternoon" opportunities on days when a medical experiment is scheduled. Trials of M171 cannot be rescheduled from "afternoon" to "morning" or vice versa to make specific opportunities available for EREP. Sufficient flexibility does exist to schedule two trials of M092 in the late "morning" by scheduling lunch later than normal. A uniform treatment of M092 is required throughout the mission, however, to schedule all trials for each subject at approximately the same time of day. M093 can be distributed in any desired manner, since all trials are relatively short (43 minutes), and there is no requirement to schedule each subject at approximately the same time of day.

An important limitation of scheduling M092, M093, and M171 in the manner depicted in Table I is that no data is obtained for M171 until the fourth mission day. M092 is also concluded two days earlier than necessary on the twenty-third mission day. Obtaining some data for each experiment as early in the mission as possible is an important scheduling objective of each of these experiments. A second consideration is that the data for each experiment covers only twenty-two days out of a possible twenty-four.

#### VII. Trials of Different Experiments on the Same Day

Some data on each of these experiments can be obtained early in the mission by scheduling trials of M092, M093, and M171 for different subjects on the same day. This approach requires scheduling one trial of M093 on each of the 24 mission days devoted to experiments, including days seven, fourteen, and twenty-one. A non-uniform spacing between the five trials per subject of the other two experiments is required to maintain a rotation of subjects within a day.



TABLE I  
TRIALS OF ONE EXPERIMENT ON THE SAME DAY

<u>Day</u>	<u>1st Crewman</u>	<u>2nd Crewman</u>	<u>3rd Crewman</u>
2	M092	M092	M092
3	M093	M093	M093
4	M171	M171	M171
5			
6	M093	M093	M093
7			
8	M092	M092	M092
9	M093	M093	M093
10	M171	M171	M171
11			
12	M093	M093	M093
13	M092	M092	M092
14			
15	M093	M093	M093
16	M171	M171	M171
17			
18	M093	M093	M093
19	M092	M092	M092
20	M171	M171	M171
21	M093	M093	M093
22			
23	M092	M092	M092
24	M093	M093	M093
25	M171	M171	M171

Trials late in the mission are given a closer spacing, where required, because some experience already exists with space missions up to fourteen days (Gemini VII). Days on which the various trials are scheduled in the sample timeline are summarized in Table II, which corresponds to Figure A-2 in the Appendix.

A major problem with this second approach is that it does not permit a day off every seventh mission day. At the very minimum, one trial of M093 would have to be performed on days off, which could be chosen as days seven, fourteen, and twenty-one. M093 would have a minimum impact on the span of time off for the subject and observer during these days, since it is scheduled just before dinner.

The sample schedule in Figure A-2 shows M092 scheduled in late "morning" opportunities and M171 scheduled in late "afternoon" opportunities, followed by M093. As in the first approach, M093 can be rescheduled as desired to accommodate EREP coverage. Once a specific opportunity has been chosen for the other two experiments, they must be scheduled consistently at the same time of day throughout the mission.

This second approach has two advantages over the first approach. First, data collected in one run of these medical experiments can be examined on the ground before another trial is run of the same experiment, in case there is any malfunction. Second, there is no need to schedule lunch at other than the normal time, except to accommodate ATM or EREP experiments.

VIII. Scheduling M092, M093, and M171 in a  
Single Trial, as Needed -- One per Day

An alternative technique, presently under consideration at MSC, is to schedule a single trial that includes M092, M093, and M171 in that order for the same subject, when all three experiments are due to be scheduled.\* This sequence can be carried out without delay between experiments only if the previously required delay between trials of M093 and M171 for

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\*Reference 6 suggests that this approach be considered.

TABLE II

TRIALS OF DIFFERENT EXPERIMENTS ON ONE DAY

<u>Day</u>	<u>1st Crewman</u>	<u>2nd Crewman</u>	<u>3rd Crewman</u>
2	M092	M093	M171
3	M171	M092	M093
4	M093	M171	M092
5		M093	
6			M093
7	M093		
8	M092	M093	M171
9	M171	M092	M093
10	M093	M171	M092
11		M093	
12	M092		M093
13	M093		M171
14		M093	
15	M171	M092	M093
16	M093	M171	M092
17		M093	
18	M092		M093
19	M093	M092	M171
20	M171	M093	M092
21			M093
22	M093	M171	
23	M092	M093	M171
24	M171	M092	M093
25	M093	M171	M092

the same subject is waived.\* The combined trial will take around two and a half hours by current estimates. This technique reduces the total time the vectorcardiogram sensors are in place as well as the total number of times each crewman has to emplace and remove them. Although the sensors are in place for a longer period of time for a combined trial, each crewman will have to serve as subject only once every third day, the required frequency for M093.

One possible schedule using this approach would contain a combined trial every day from the second crew day to the twenty-fifth crew day, rotating subjects between days. Days on which the various trials could be scheduled are shown in Table III. Either all trials would have to be scheduled in late "morning" opportunities, or all trials would have to be scheduled in late "afternoon" opportunities, except where M093 is scheduled alone.

This schedule would have no days during the mission that are completely free of medical experiments. It would be possible to schedule days seven, fourteen, and twenty-one as days off with the exception that one combined medical trial must be performed on each of these days. Each crewman would have to serve as subject on a day off only once during the mission.

An advantage of this approach is that all trials can be scheduled late in the day, leaving approximately seven and a half hours free of medical experiments. If the crew day is phased so that the best lighting over the U.S. is centered within these seven and a half hours, there would be a minimum amount of interference between these medical experiments and real-time scheduling of EREP experiments.

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\*M093 involves ergometer exercise at a relatively low level (150 watts) for two minutes. In the judgment of the principal investigator, this short period of exercise will not have significant carry-over effects on M171 if performed sooner than two hours on the same subject (Reference 6). The ground rules in the Appendix require a two-hour delay after exercise before performing M171.

TABLE III

ONE SEQUENTIAL TRIAL ON EACH EXPERIMENT DAY

<u>Day</u>	<u>1st Crewman</u>	<u>2nd Crewman</u>	<u>3rd Crewman</u>
2	M092/M093/M171	--	--
3	--	M092/M093/M171	--
4	--	--	M092/M093/M171
5	M093	--	--
6	--	M093	--
7	--	--	M093
8	M092/M093/M171	--	--
9	--	M092/M093/M171	--
10	--	--	M092/M093/M171
11	M093	--	--
12	--	M093	--
13	--	--	M093
14	M092/M093/M171	--	--
15	--	M092/M093/M171	--
16	--	--	M092/M093/M171
17	M093	--	--
18	--	M093	--
19	--	--	M093
20	M092/M093/M171	--	--
21	--	M092/M093/M171	--
22	--	--	M092/M093/M171
23	M092/M093/M171	--	--
24	--	M092/M093/M171	--
25	--	--	M092/M093/M171

### IX. Scheduling Up to Two Sequential Trials on One Day

It is also possible to schedule two sequential trials on the same day, one in the late "morning" and one in the late "afternoon" of the crew day. Days on which the various trials could be scheduled are shown in Table IV. This strategy leaves every third day free of any trials of M092, M093, or M171. Days seven, thirteen, and nineteen could be chosen as days off, for example.

Very little flexibility exists to accommodate real-time scheduling of EREP on days containing two sequential trials of M092, M093, and M171. There are five days during the mission on which two medical trials are scheduled that include all three experiments. This limitation would be significant only if the days on which EREP can be performed happened to be concentrated around times when two combined trials are scheduled.

### X. Summary

Trade-offs exist in scheduling M092, M093, and M171 with respect to present ground rules for daily crew activities, time for days off during the mission, and maximum availability of EREP opportunities. Four possible approaches to scheduling these three medical experiments on SL-1/SL-2 are reviewed with respect to these topics. The first two schedule up to three separate trials on one crew day with a rotation of subjects within the day. Two alternative approaches schedule the three experiments sequentially in a single trial for the same subject, when trials of all three experiments are required.

1. Three trials of the same experiment on one day (Table I)
2. Up to three trials of different experiments on the same day (Table II)
3. One sequential trial per day (Table III)
4. Two sequential trials on one day, as needed, to permit some days off (Table IV).

Looking first at medical aspects, constraints stated in the Appendix are met by all four schedules with one exception. Ergometer exercise during M093 is not regarded as a constraint on performing M171 sequentially

TABLE IV

TWO SEQUENTIAL TRIALS ON SOME EXPERIMENT DAYS

<u>Day</u>	<u>1st Crewman</u>	<u>2nd Crewman</u>	<u>3rd Crewman</u>
2	M092/M093/M171	M092/M093/M171	--
3	--	--	M092/M093/M171
4	--	--	--
5	M093	M093	--
6	--	--	M093
7	--	--	--
8	M092/M093/M171	M092/M093/M171	--
9	--	--	M092/M093/M171
10	--	--	--
11	M093	M093	--
12	--	--	M093
13	--	--	--
14	M092/M093/M171	M092/M093/M171	--
15	--	--	M092/M093/M171
16	--	--	--
17	M093	M093	--
18	--	--	M093
19	--	--	--
20	M092/M093/M171	M092/M093/M171	--
21	--	--	M092/M093/M171
22	--	--	--
23	M092/M093/M171	M092/M093/M171	--
24	--	--	M092/M093/M171
25	--	--	--

for the same subject. This issue is never raised in the first two approaches, since the same subject performs only one trial on any given day.

Emplacement and removal of the M093 electrodes is minimized by either of the schedules in Tables III and IV. The total time the electrodes are in place is also minimized, but they remain in place longer each time they are worn.

Both of the schedules in Tables III and IV require an uneven spacing for one of the five trials per subject of M092 or M171, because the same subject must perform M093 only at intervals of every three days. Rotating subjects within a day, as in Tables I and II, permits a more even spacing of these five trials, although some trials are still scheduled closer together than others.

Data for all three medical experiments is obtained earliest in the mission with the schedule summarized in Table IV. One trial of each experiment for all crewmen has been completed by the third crew day. The schedules summarized in Tables II and III gather some data for all three experiments on the second mission day, but do not complete the cycle for all three crewmen until the fourth mission day.

The schedules in Tables II and III do permit review of one day's data on the ground before the next trial of each experiment is to be run. They also permit scheduling of lunch at the normal time for all crewmen, unless other factors such as an EREP opportunity call for rescheduling lunch on a particular day.

Turning to the impact of these schedules on other activities, only two of the four schedules provides days off during the mission. The schedule summarized in Table I permits days off on the seventh and fourteenth mission days, as desired, but delays the third day off until the twenty-second mission day in order to maintain the required frequency for M093. The schedule summarized in Table IV permits days off at intervals of six or nine days between. At least one trial of M093 would have to occur on days off in the other two schedules. The schedule summarized in Table III would require each crewman to serve as subject in a medical trial on only one day off, if these days are chosen as seven, fourteen, and twenty-one.

The late "afternoon" portion of the crew day is unavailable for systems housekeeping on days when medical trials are scheduled at this time, because one crewman is at the ATM console. By assumption, systems housekeeping tasks will be scheduled at other times during the day under these circumstances. All schedules require some adjustment



of systems housekeeping time, unless the approach outlined in Table III happened to put all medical trials in late "morning" opportunities.

Trials of M092 and M171 cannot be rescheduled from late "morning" to late "afternoon" opportunities and vice versa on a real-time basis in any of the schedules. Some blocking of potential EREP opportunities may be expected from these experiments. The only possible exception is the schedule outlined in Table III, where all medical trials can be scheduled in the late "afternoon". If acceptable lighting for EREP is limited to a span of about seven and a half hours over the U.S., the twenty-four hour crew day can be phased so that medical experiments do not interfere directly with EREP opportunities.



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Attachment

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REFERENCES

1. Minutes of the Twenty-Eighth Skylab Program Flight Operations Plan (FOP) Meeting, Flight Control Division, MSC, August 6, 1970, Enclosure 12.
2. Belz, D. J., Flight Planning for Earth Resources Observations During the First Skylab Mission, Bellcomm Memorandum B70 07082, July 27, 1970.
3. Experiment Requirements Document for Inflight Lower Body Negative Pressure (LBNP) (Experiment M092), MSC, October 1969.
4. Experiment Requirements Document for Vectorcardiogram (Experiment M093), MSC, June 24, 1970.
5. Experiment Requirements Document for Metabolic Activity (Experiment M171), MSC, July 1, 1970.
6. Sequential In-flight Scheduling of Experiments M092, M093, and M171, Memorandum to CF/Chief, Flight Crew Support Division from DB/Chief, Biomedical Laboratories Division, MSC, August 20, 1970.

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## APPENDIX - SAMPLE TIMELINES FOR M092, M093, AND M171

### I. Introduction

Two sample timelines for scheduling Experiments M092, M093, and M171 are presented in this appendix. Both are developed from the same set of objectives and constraints, listed in the following two sections. In the first sample schedule (Figure A-1), the objective to schedule days off from routine experiment activity is given priority over the objective to obtain some data on each experiment as early in the mission as possible. The second schedule (Figure A-2) reverses this priority. Trials of medical experiments are placed arbitrarily just prior to meals with a minimum displacement of lunch, when required. All of the constraints listed in Section III are met by both schedules.

The purpose of these timelines is simply to illustrate problems that currently exist in meeting the scheduling objectives listed in Section II. Crew time required for daily tasks is blocked out, and the three medical experiments are scheduled in acceptable relationships to these activities. More detailed scheduling would have to account for many other factors that are not required for an overall look at the problem.

### II. Objectives

The following scheduling objectives are used as a basis for the analysis contained in this memorandum:

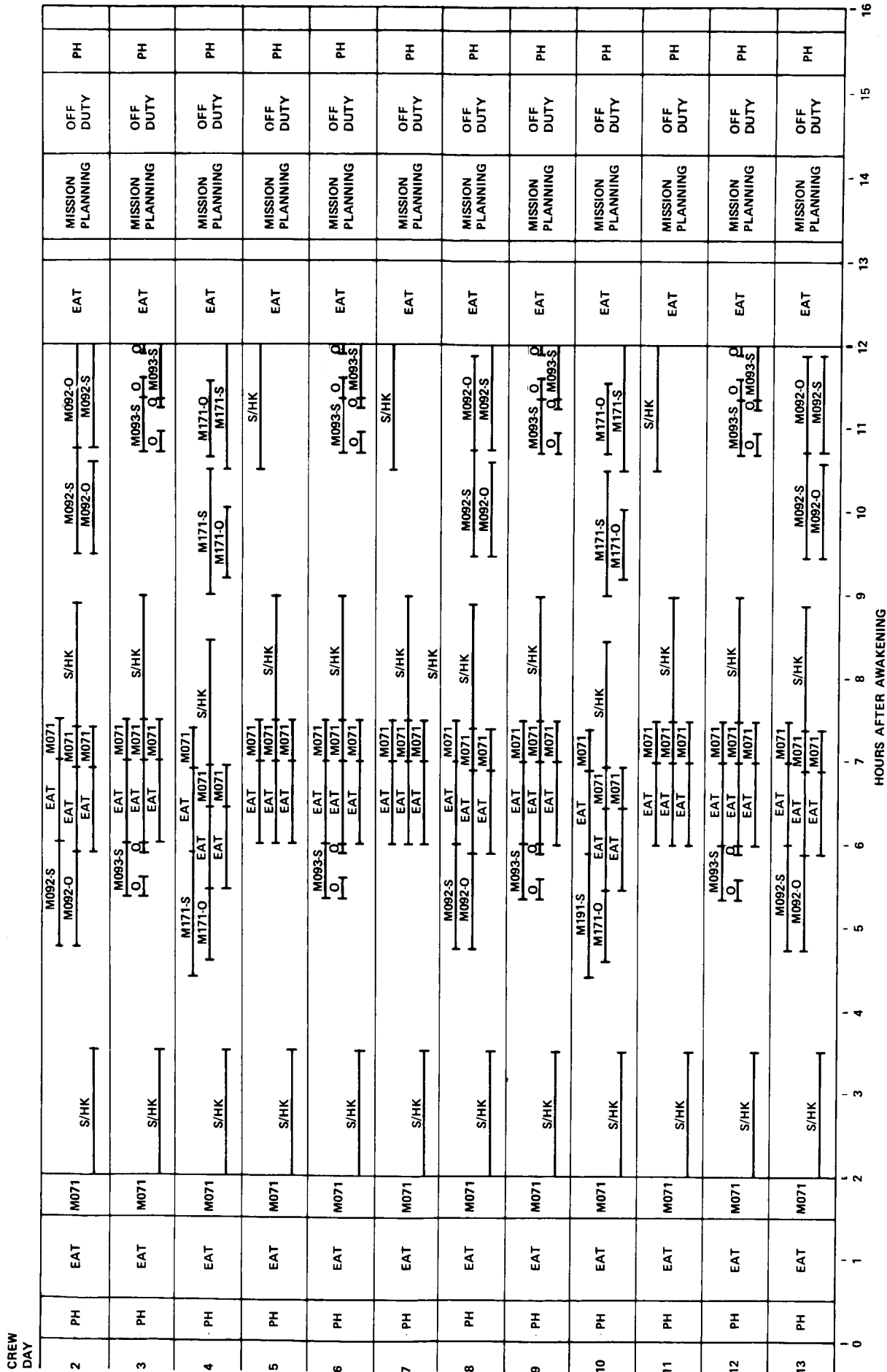
1. Daily crew activity during the on-orbit phases of the mission is as shown in Figure 1, p. 3.
  - a. A fourteen-hour period during each day is fully committed to daily activities that include dinner, mission planning, off-duty, sleep, breakfast, and other activities as shown.
  - b. A one-hour lunch period is normally scheduled for all three crewmen six hours after awakening. One of the three crewmen remains at the ATM console during lunch.
  - c. Activities assigned to M071 are scheduled in half-hour periods following breakfast and lunch for each crewman and in fifteen-minute periods during the "evening" of the crew day.

- d. Systems housekeeping tasks are scheduled arbitrarily as three one and one-half hour periods of one-man activity at the times shown in Figure 1. A rotation of these tasks among the crewman is desirable during each day. The distribution of time actually required for systems housekeeping may be expected to change somewhat as detailed tasks are identified and scheduled individually.
  - e. Personal hygiene is scheduled in half-hour periods for each crewman before and after sleep and at some time during the "afternoon" of the crew day.
2. A day off from routine experiment operations is to occur every seventh full day of the mission. ATM or EREP experiments might be run on one of these days, however, if a solar flare or favorable earth-resources opportunity should occur.
  3. The ATM console is to be manned almost continuously during hours normally devoted to experimentation, except when the cluster is being maneuvered to a local-vertical attitude for earth resources experiments. One astronaut eats lunch at the console, if necessary, to avoid interruption of ATM manning, and one man is at the console for one orbit in the "evening" while the others are doing mission planning or are off duty.
  4. Trials of M093, Vectorcardiogram, are to be scheduled at a frequency of every third day for each crewman.
  5. Five trials per crewman are required for all three crewmen of both M092, In-flight LBNP, and M171, Metabolic Activity. Presumably the five trials for each subject are to be scheduled as evenly as possible throughout the mission, beginning as early as possible and ending as late as possible. To the extent that an even spacing between trials is not possible, it is assumed that a higher frequency of trials is of most interest late in the mission.
  6. One trial per subject of M092, M093, and M171 should be scheduled as early in the mission as possible.
  7. It is assumed that emplacement of the vectorcardiogram electrodes for M092, M093, or M171 should not be required more than once per day for the same crewman if it can possibly be avoided. Emplacing and removing the sensors causes skin irritation.

III. Constraints

Scheduling of these objectives as blocks of crew time is subject to the following constraints for purposes of this study:

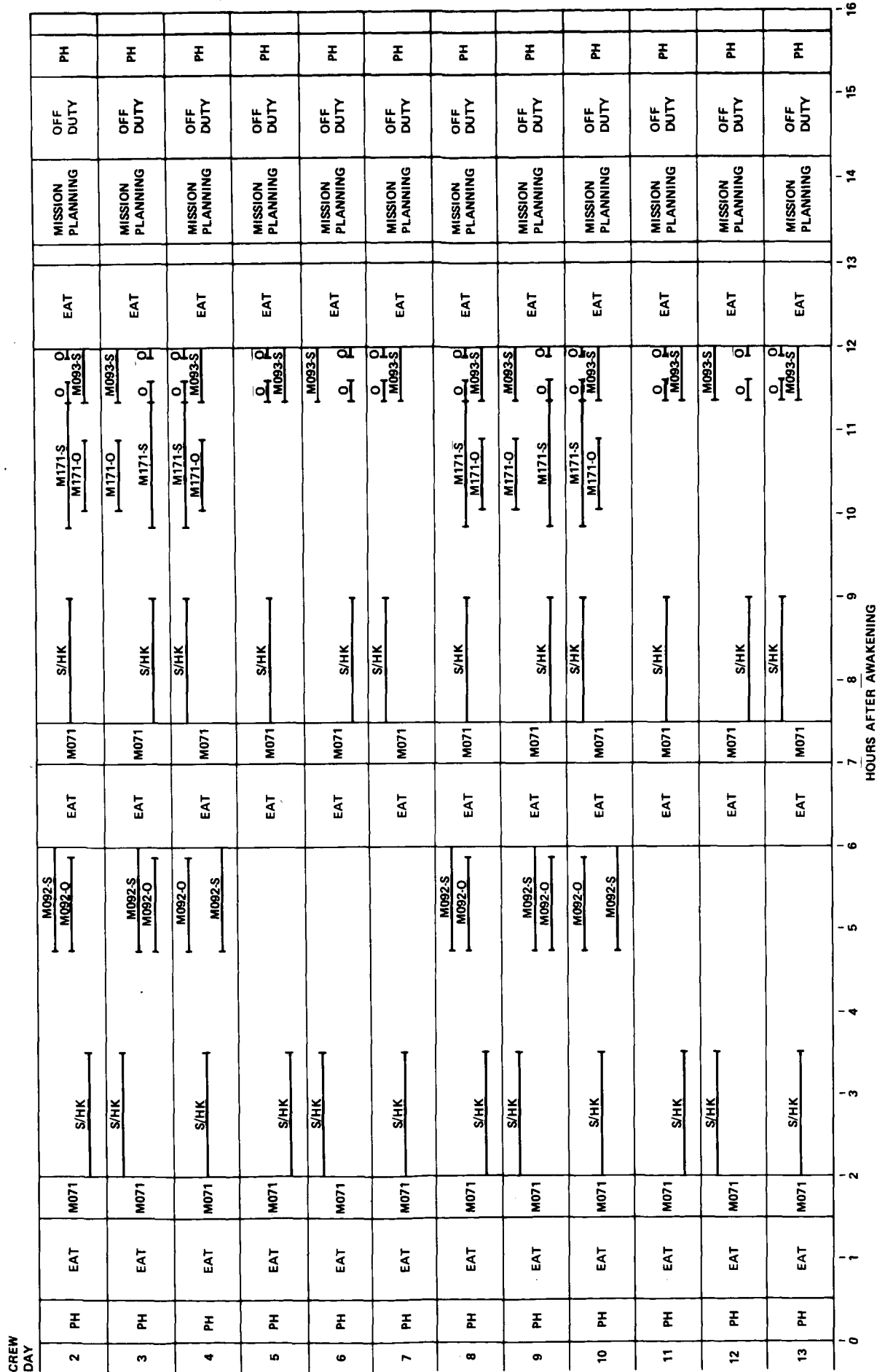
1. Sleep occurs every twenty-four hours, with no changes in the schedule of the surrounding activities from dinner to M071 following breakfast.
2. Deviations in scheduling lunch of up to one hour may be tolerated, if required.
3. Experiments must be scheduled between the second full crew day of the mission and the twenty-fifth crew day to allow time for OWS activation and deactivation. The twenty-sixth mission day is reserved primarily for EVA.
4. Experiments M092, M093, and M171 cannot be scheduled simultaneously, including preparation and deinstrumentation phases for each subject. Exclusion of simultaneous preparation and deinstrumentation is based on a conservative assumption that only one subject at a time can occupy the area of the ESS.
5. Test phases of M092, M093, and M171 should be preceded by at least three hours of fasting by the subject.
6. Trials of M092 and M171 must be done at approximately the same time of day for each subject.
7. Test phases of M093 must follow test phases of M092 or M171 for the same subject by at least one-half hour.
8. Test phases of M092 must follow ergometer exercise by the same subject during M093 or M171 by at least two hours.
9. Test phases of M171 must follow test phases of M093 for the same subject by at least two hours.



- (1) SEE NOTES ON FIGURE 1  
 (2) 1.5 HRS. OF S/HK MUST BE ADDED FOR A THIRD CREWMAN ON DAYS CONTAINING MEDICAL TRIALS

FIGURE A-1 DIFFERENT TRIALS OF ONE MEDICAL EXPERIMENT ON THE SAME CREW DAY

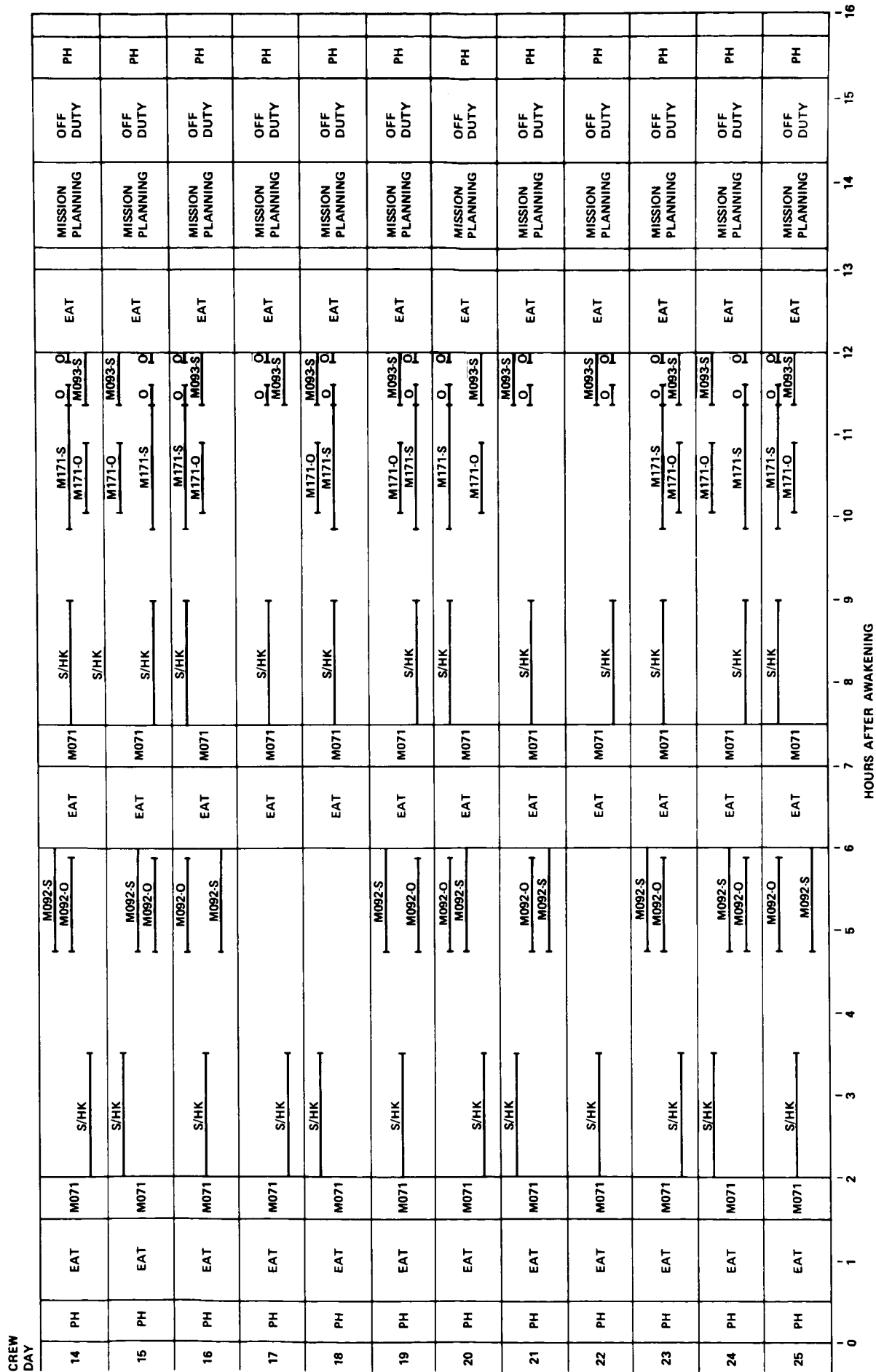




(1) SEE NOTES ON FIGURE 1  
 (2) 1.5 HRS. OF S/HK MUST BE ADDED FOR A THIRD CREWMAN ON DAYS CONTAINING MEDICAL TRIALS

FIGURE A-2 TRIALS OF DIFFERENT MEDICAL EXPERIMENTS ON THE SAME CREW DAY





- (1) SEE NOTES ON FIGURE 1  
 (2) 1.5 HRS. OF S/HK MUST BE ADDED FOR A THIRD CREWMAN ON DAYS CONTAINING MEDICAL TRIALS

FIGURE A-2 (CONT.) TRIALS OF DIFFERENT MEDICAL EXPERIMENTS ON THE SAME CREW DAY

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Subject: Scheduling of Three Skylab  
Medical Experiments - Case 610

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